SEED CHARACTERS IN SOME NATIVE AMERICAN VETCHES[1]

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INTRODUCTION

Hermann (1960) and Gunn (1965, 1970, 1971) have used seed characters for identifying species of *Vicia* (vetch). Hermann used the relative hilum length, which is a percentage figure calculated as hilum length/seed circumference × 100. Gunn (1970) lists four seed characters as being reliable in identification: seed circumference, relative hilum length, hilum shape, and relative position of the lens to the hilum. The lens or strophiole is a protuberance or swelling on the seed margin between the hilum and chalaza and is derived from integumentary tissue (Kopooshian and Isely, 1966).

The relationship of *Vicia ludoviciana* Nutt., *V. leavenworthii* T. & G., *V. exigua* Nutt. and the varieties of each have been interpreted differently by recent workers (Shinners, 1948; Turner, 1956; Isely, unpublished manuscript; Lassetter, 1972). During a taxonomic study of this native complex occurring from Alabama to California, and northern Mexico into the Rocky Mountains, Lassetter (1972) examined seed characters to evaluate their taxonomic usefulness. The features studied were relative hilum length, seed diameter (substituted for circumference because the seeds are essentially spherical), hilum shape (determined by measuring the hilum width at each end), color of testa, and color of mottled portion of testa (if present). The distance between the lens and hilum was not measured because it is essentially identical in these vetches.

MATERIALS AND METHODS

A total of 60 seed samples was analyzed. Except for four samples, each one contained field-collected seeds from many plants of a single population. The samples, then, were collected from populations and were not just seed from a single plant. The remaining four samples were obtained from greenhouse specimens grown from seeds taken from herbarium sheets.

Each sample was poured into a petri plate with 25 evenly spaced marks,

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Table 1. Relative hilum lengths in the *V. ludoviciana* complex.

Taxon	Hermann (1960)	Gunn (1965, 1971)	Lassetter	Number of samples
V. ludoviciana var. *ludoviciana* (= defunct var. *typica*)	25—33	30	25.9—37.9	16
V. ludoviciana var. *laxiflora*		none given	16.2—21.8	5
V. ludoviciana var. *texana*		23	17.7—25.8	15
V. leavenworthii var. *leavenworthii* (= defunct var. *typica*)	ca. 25	22	19.0—22.6	16
V. leavenworthii var. *occidentalis*		19—21	10.0—14.7	4
Louisiana type			45.6	1
V. exigua var. *exigua*	20	14—17	19.5—21.6	3

and data were taken from the 25 seeds on or nearest the marks. Observations were made at 10x or 20x through a stereoscopic microscope equipped with an ocular micrometer. Measurements were recorded to the nearest 0.1 mm except for hilum width, which was recorded to the nearest 0.01 mm.

The colors were subjectively observed and numerically recorded (see Lassetter, 1972).

A correlation coefficient matrix was computed to show related variation between the following: seed diameter, relative hilum length, hilum length, hilum width at wide end, hilum width at narrow (lens) end, base color of testa, and color of mottling. Means of the data were used as input. The longitude and latitude of the mass collection site were also entered as data to determine if any correlation between site and seed characters existed.

RESULTS AND DISCUSSION

Table 1 contains the relative hilum length as reported by Hermann (1960), Gunn (1965, 1971), and from this study. Values from Hermann (1960) are for species only. In Gunn's data, values for *V. ludoviciana* var. *ludoviciana* and *V. leavenworthii* var. *leavenworthii* are from Gunn (1971); values for other taxa are from Gunn (1965). The number of samples refers to Lassetter's data, which are the minimum and maximum sample means for each taxon. The Louisiana type is a vetch previously recognized as *V. ludoviciana* var. *ludoviciana*, but which has characteristics closely resembling *V. leavenworthii* var. *leavenworthii*, and it was studied as a separate entity.

The names used by Hermann, Gunn, and Lassetter in Table 1 represent the same taxa concept except for one case. *Vicia exigua* var. *exigua* sensu Hermann occurred from California to Texas. *Vicia exigua* var. *exigua* sensu Gunn occurred from California to Arizona, New Mexico, and Utah, and was not present in Texas, the southern Texas plants being assigned to *V. leavenworthii* var. *occidentalis*. *Vicia exigua* var. *exigua* sensu Lassetter occurred only in California; the Arizona, New Mexico, and Utah plants, as well as the southern Texas plants, being assigned to *V. leavenworthii* var. *occidentalis*. Some of the differences in Table 1 between my data and that of previous workers may be due to differences in taxa concept and in application of taxa names.

The overlap of relative hilum length is clearly shown (Fig. 1) when the mean values for each population sample are arranged in graphical form. Three main breaks in the values are present. The Louisiana type is distinct, with 46 percent. All the other samples with values above 30 percent are *V. ludoviciana* var. *ludoviciana*, and only one sample of this taxon was less than 30 percent. The three samples with values of 10–15 percent are *V. leavenworthii* var. *occidentalis*. The largest group of samples falls into the 16–26 percent range and includes all types except *V. leavenworthii* var. *occidentalis* and the Louisiana type.

If a plus-one standard deviation and a minus-one standard deviation of each sample are considered, the resulting overlap of values is great enough

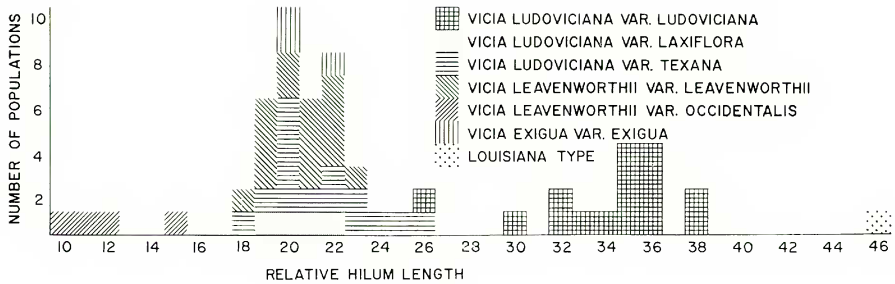

Figure 1. Means of relative hilum lengths.

to produce a continuum of values from 9 percent (*V. leavenworthii* var. *occidentalis*) to 40 percent (*V. ludoviciana* var. *ludoviciana*) (Lassetter, 1972). If the total range of variation in each sample is considered, the breaks in Fig. 1 at 13 percent and 40–45 percent disappear (Lassetter, 1972).

From Table 2, the diameter of most seeds is between two and three mm, with only a few types having larger or smaller seeds. The overlap that exists precludes delimiting these vetches by seed diameter.

Gunn (1970, 1971) gives the hilum shape of *V. ludoviciana* and *V. exigua* as oblong (with parallel sides) and, of *V. leavenworthii*, as wedge (with tapering sides). My data confirm the oblong shape for the first two species, but variation in hilum shape within individual samples of *V. leavenworthii* was observed. Some population samples contained seeds with oblong hila, as well as seeds with wedge-shaped hila. Because of intrapopulational variation, this character is not wholly useful inasmuch as all three species can have oblong hila.

The base color and mottling also varied within individual samples. Some samples were uniformly colored, and others consisted entirely of mottled seeds. Other samples, however, contained a mixture of mottled and uniformly colored seeds. I believe that color variation is not due to the stage of seed maturity, because seeds were collected from plants with completely ripened legumes.

Table 3 contains correlation coefficients of longitude, latitude, and seven seed characteristics. The highest correlation is between hilum length and relative hilum length. This correlation indicates that these two characters are related, but are not dependent on the diameter of the seed, with which they correlate at 0.36 and 0.06, respectively. The wide-end and narrow-end width of the hilum correlate at 0.92. The usefulness of hilum shape was discussed earlier. The wide-end width of the hilum correlates at 0.50 with seed diameter, indicating that hilum width is somewhat related to seed size.

The distribution of the *V. ludoviciana* complex is primarily east-west, and longitude correlated with hilum length and relative hilum length at 0.50 and 0.66 respectively. The samples with the shortest hila and shortest relative hilum length are from the arid southwestern United States. This correlation may indicate an adaptive character of survival value in that environment. Many papilionoid legumes are termed hard-seeded because their seed coats are impervious, and do not imbibe water (Hyde, 1954). The hilum of hard-seeded legumes functions in producing the proper level of seed dessication. Once the moisture content has dropped to about 14 percent, the seed coat becomes impermeable and further dehydration is accomplished by moisture loss through the hilar fissure (Hyde, 1954). A small hilum could be advantageous in reducing excessive moisture loss from seed in extremely arid environments.

According to Gunn (1971), other native North American vetches occurring in the same general xeric areas also have rather small relative hilum lengths: *V. americana*, 20-33%; *V. leucophaea*, 23%; and *V. pulchella*, 26%.

Table 2. Seed diameter in mm.

Taxon	Min.	Minus One S'd. Dev.	Mean	Plus one Std. Dev.	Max.
V. ludoviciana var. *ludoviciana* (= defunct var. *typica*)	1.80	2.08	2.32	2.56	2.68
V. ludoviciana var. *laxiflora*	1.92	1.99	2.17	2.35	2.30
V. ludoviciana var. *texana*	1.80	1.97	2.15	2.33	2.35
V. leavenworthii var. *leavenworthii* (= defunct var. *typica*)	1.92	2.07	2.30	2.53	2.78
V. leavenworthii var. *occidentalis*	2.12	2.09	2.43	2.77	2.90
Louisiana type	2.60	2.62	2.77	2.92	3.30
V. exigua var. *exigua*	2.75	2.67	2.94	3.21	3.23

Table 3. Correlation coefficients of longitude, latitude, and seven seed characteristics.

	Longitude	Latitude	Seed diameter	Base color	Mottling color	Hilum length	Hilum width at wide end	Hilum width at narrow end	Relative hilum length
Longitude	1.00								
Latitude	.37	1.00							
Seed diameter	.34	.43	1.00						
Base color	.24	.01	.01	1.00					
Mottling color	.11	.08	.05	.10	1.00				
Hilum length	.52	.10	.36	.06	.27	1.00			
Hilum width at wide end	.10	.37	.36	.27	.17	.33	1.00		
Hilum width at narrow end	.07	.38	.50	.26	.28	.39	.92	1.00	
Relative hilum length	.66	.02	.06	.03	.32	.94	.22	.27	1.00

Additional native species with a relative hilum length of 75% (*V. acutifolia, V. caroliniana, V. floridana, V. gigantea, V. minutiflora, V. ocalensis*) are mostly of the eastern and southeastern United States, where habitats are more mesic. *Vicia cracca* (33%) is circumpolar, and *V. humilis* (30%) is of wet pine woodlands and meadows of Mexico.

CONCLUSIONS

All the characters evaluated are variable. The overlap between the three species and between varieties within species is evident. In addition, seed coloring and hilum shape varied within individual samples, and because of intrapopulational variation cannot be used effectively to differentiate the taxa.

The relative hilum length and other seed characters may be useful for identification of other groups of *Vicia* species and are valuable in combination with other morphological characteristics for identification purposes. Because of the overlap due to wide variation demonstrated in these characters, I believe it unwise to base identification of taxa in this complex on seed characters alone.

The distribution of most taxa of the complex is centered in a different area (Lassetter, 1972). Portions of ranges often overlap, but the centers of distribution usually do not. Occurrence of the taxa of this complex is in part related to edaphic factors (Shinners, 1948; Turner, 1956; Lassetter, 1972). The intraspecific differences in relative hilum length of varieties may indicate an ecotypic adaptation of those taxa to other nonedaphic environmental factors.

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